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[12]实用新型专利说明书

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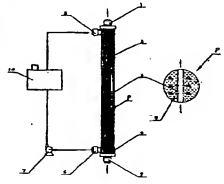
[54]实用新型名称 膜式混合气体组份脱除器

[57]摘要

膜式混合气体组份脱除器。其壳体内设置疏水性聚丙烯或聚乙烯中空纤维微孔膜;在壳体上装有混合气体进出口管嘴和吸收液的进出口管嘴。中空纤维微孔膜可采用片状组件或圆柱形结构,在吸收液管道上设有泵和吸收液贮存池,以补充消耗了的吸收液。这种装置,对混合气体组份具有高的选择性分离,特别对混合气体中酸性组份或碱性气体组份的脱除率可高达 90～98%,并且在吸收液一侧还可得到有用的高纯产物。



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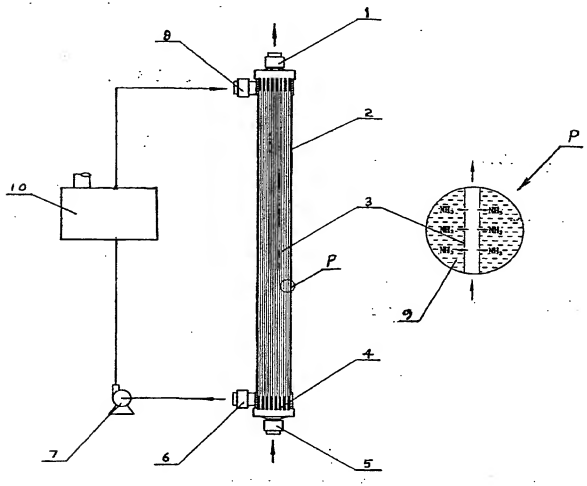
权利要求书

1、膜式混合气体组份脱除器，其特征是在外壳内装有疏水性聚丙烯或聚乙烯中空纤维微孔膜，外壳上设置混合气体进出口管咀和吸收液的进出口管咀，混合气体充满中空纤维膜内外两侧，而吸收液充满中空纤维外侧间隙，吸收液能与混合气体中要分离的组份，发生不可逆化学反应。

2、根据权利要求 1 所述膜式混合气体组份脱除器，其特征是外壳（2）内装有圆柱形的中空纤维微孔膜（3）；外壳上设有混合气体的进口管咀（5）和分离脱除组份后的包含其余组份的混合气体的出口管咀（1）；外壳上还装有吸收液的进口管咀（8）和出口管咀（6），管路上装有泵（7）和吸收液贮存池（10）。

说　明　书　附　图



说明书

膜式混合气体组份脱除器

本实用新型属于从混合气体中分离组份的设备。

目前膜法分离混合气体组份的产品，已得到广泛应用。产品采用的膜材质一般都是致密膜，如聚酰亚胺、聚醚砜等。利用膜材质对气体溶解扩散机理，根据膜材料对气体的不同选择性实现混合气体组份的分离。

这种现有产品存在以下不足：

1、膜两侧需较大压力差，使设备复杂，增加生产成本；

2、致密膜材料对气体选择分离因子往往与气体透过速率成反比，即气体透过速率大，则分离因子小，因而限制了气体分离效率；

3、致密膜材料对气体具有不同选择透过性，如气体改变了，就要选择不同的致密膜，给生产使用带来不便。

本实用新型针对现有技术存在的问题，提供一种在常压条件下使用的膜式混合气体组份脱除器，结构简单，使用方便，生产成本低廉，分离效率高。

为实现上述目的，采用技术方案如下：

膜式混合气体组份脱除器外壳内装有片状组件或圆柱形结构的疏水性聚丙稀或聚乙稀中空纤维微孔膜，外壳上设有混合气体进口管咀和分离组份后的剩余组份的出口管咀；以及相应吸收液体的进、出口管咀。

中空纤维微孔膜组件由极细纤维组成，每根纤维中空，其壁上分布有微孔，混合气体各组份充满中空纤维膜内外两侧，并可从纤维内侧透过膜壁微孔进入外侧；而由于中空纤维微孔膜的疏水性，吸收液不能从纤维外侧透过微孔进入内侧，吸收液只是充满中空纤维外侧间隙。对于不要求分离脱除的气体组份不与吸收液发生化学反应，因而在微孔两侧进出平衡；而要求从混合气体中分离脱除的组份，在透过膜壁微孔后立即与相应吸收液发生不可逆化学反应，使该组份在膜纤维内外两侧形成较大压力差，推动该组份气体从混合气体一侧源源不断进入膜纤维另一侧与吸收液进行连续地不可逆化学反应，实现从混合气体中分离组份的目的。

本实用新型的实质性特点及进步：

1、利用聚丙烯或聚乙稀中空纤维微孔膜的微孔性和透气性，保证气体

能以大的透过速率通过膜壁；

2、该技术以膜为界，气相、液相各行其道，两相流动、压力大小均可分别控制，环境压力采用常压，不需复杂的加压装置，结构简单，成本低廉，推广使用方便；

3、利用需分离的气体组份与吸收液的不可逆化学反应，造成微孔两侧气压差为推动力，能使该组份实现高的选择性分离，对混合气体中酸性组份或碱性气体组份的脱除率可高达 90~98%之间，在吸收液一侧还可得到有用产物，其纯度高，可用于制备试剂级产品。

参照附图详细说明技术方案的实施方式：

附图为本实用新型一种实施方式的结构示意图。外壳 2 采用塑料 ABS 管，外壳内装有圆柱形的疏水性的中空纤维微孔膜，它由中空壁上有微孔的极细纤维 3 组成，膜两端用环氧树脂 4 粘合，疏水性中空纤维微孔膜材料采用聚丙烯或聚乙烯；外壳 2 上设混合气体（如氨铜洗再生气，由 CO、NH_3、H_2、N_2等组份组成）的进口管咀 5 和分离脱除组份后的出口管咀 1，外壳上还装有吸收液（如硫酸）的进口管咀 8 和出口管咀 6，管路上设有泵 7 和吸收液贮存池 10，以补充供给吸收液。如附图中局部放大图 P 所示，各中空纤维 3 外的所有间隙都充满吸收液（硫酸）9，吸收液不能透过纤维壁上微孔进入纤维中孔；而混合气体组份 CO、NH_3、N_2、H_2 从纤维中孔透过微孔可进入吸收液中，但只有要求分离脱除的组份 NH_3与吸收液硫酸能发生不可逆化学反应：$NH_3+H^+ \rightarrow NH_4^+$，并可源源不断产生硫胺溶液，经后处理可得到精制硫铵，剩余无 NH_3的其它如 CO、H_2、N_2等组份经出口管咀 1 排出，实现了分离脱除 NH_3组份的目的。

另一种实施例是在聚丙烯中空纤维微孔膜中通入混合气体沼气或天然气，其中主要组份是 CH_4、H_2S 和 CO_2，要求分离脱除 CO_2和 H_2S 组份。采用吸收液 NaOH，因 H_2S 与 CO_2和 NaOH 能发生不可逆化学反应，只有 CH_4不能发生化学反应，这样，就可分离脱除 CO_2和 H_2S 组份，实现获得纯 CH_4的目的。

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Title of the Utility Model: A Membrane-type Component Eliminator for Mixed Gas

Abstract

A membrane-type component eliminator for mixed gas is provided. A hydrophobic hollow fiber microporous membrane formed by polypropylene or polyethylene is provided within the case of the eliminator. The eliminator is provided with inlet and outlet nozzles for mixed gas and absorbing solution, respectively, on the case thereof. The hollow fiber microporous membrane can be formed in sheet-like module or cylindrical structure. A pump and a reservoir are provided on the upstream of the absorbing solution pipeline so as to supply the consumed absorbing solution. The eliminator is capable of implementing a high-selective separation to mixed gas, and has an eliminating ratio up to 90 to 98% for neutral-acidic component or basic component in the mixed gas especially. Additionally, a useful product of high-purity can be obtained on the absorbing solution side.

Claims

1. A membrane-type component eliminator for mixed gas characterized in that a hydrophobic hollow fiber microporous membrane formed by polypropylene or polyethylene is provided within the case thereof, inlet and outlet nozzles for mixed gas and for absorbing solution are provided on the case thereof, both of the inner side and outer side of the hollow fiber membrane are filled with mixed gas while a gap on the outer side is filled with absorbing solution, wherein the absorbing solution can react irreversibly with components in the mixed gas to be eliminated.
2. A membrane-type component eliminator for mixed gas according to claim 1, wherein a hydrophobic hollow fiber microporous membrane (3) is provided within the case (2), an inlet nozzle (5) for the mixed gas and an outlet nozzle (1) for the mixed gas after component separation and comprising other components are provided on the case, an inlet nozzle (8) and outlet nozzle (6) for the absorbing solution are also provided on the case, a pump (7) and a absorbing solution reservoir (10) are provided on the pipeline.

Specification

The present utility model belongs to equipments for separating components from mixed gas.

Products for separating components from mixed gas using membrane have been widely

applied currently. Membranes for such products are generally dense membranes formed by polyimide and polyethersulfone. Separation of components from mixed gas can be realized according to the dissolve-diffuse mechanism of membrane to gas and different selectivity of membrane to gas. There are the following problems for the existing products.

1. The pressure difference between the two sides of membrane needs to be large, resulting a complicated equipment and high producing cost;
2. The selective separation factor of the dense membrane material to gas is inverse proportional with gas permeation speed, that is, larger the gas permeation speed, smaller the separation factor, thus deteriorating the effect of the gas separation;
3. The dense membrane exhibits different gas separation speed with respect to different gases. It is inconvenience in practice to change the membrane when the objective gas changes.

Regarding the problems of the prior techniques, the present utility model provides a membrane-type component eliminator for mixed gas used under atmospheric pressure, which is simple in structure, easy to use, and has a low production cost and a high separation efficiency.

In order to obtain the above objectives, the following technical solution was carried out.

Within the case of the membrane-type component eliminator for mixed gas, a sheet-like or cylindrical hydrophobic hollow fiber microporous membrane formed by polypropylene or polyethylene is provided. In addition, the eliminator is provided with an inlet nozzle for the incoming mixed gas and an outlet nozzle for the mixed gas after component separation and comprising other components on the case. A pair of inlet and outlet nozzles for the absorbing solution is also provided.

The hollow fiber microporous membrane module is composed by ultrafine fibers that are hollow and provided with micropores over the inner wall. Each component of the mixed gas fills both the inner and outer side of the hollow fiber membrane, and can enter into the outer side from the inner side of the membrane through micropores on the membrane wall. However, the absorbing solution cannot enter into the inner side through micropores due to the hydrophobic property of the hollow fiber microporous membrane, but fill the gap on the outer side of the hollow fiber. For gaseous components that are not to be eliminated and do not react with absorbing solution, a balance between the inside and outside of the micropores can be achieved. The component that is to be eliminated from the mixed gas reacts irreversibly with absorbing solution right after passing through the micropores on the membrane wall. Thus, a relatively big pressure difference of the component appears between the inside and outside of the membrane fiber, which push the component to

continuously enter from the mixed gas side into the other side and react irreversibly with absorbing solution with nonstop so as to realize the purpose of separating the component from the mixed gas.

The substantive features and progress of the present utility model are as follows.

1. The microporosity and permeability of the polypropylene or polyethylene hollow fiber micorporous membrane ensure the large permeation speed of the gas passing through the membrane wall;
2. In the present utility model, a membrane is set as the boundary. Gas phase and liquid phase each has its own path. The flow and pressure can be controlled independently. The environment pressure is atmosphere and no pressure equipment is required. The structure is simple. It has a low production cost and is easy to use;
3. By using the irreversible chemical reaction between the gaseous component to be eliminated and the absorbing solution, a pressure difference between the both sides of the microporous membrane can be obtained, which drives the selective separation of the component to a high extend. For neutral-acid component or basic component in the mixed gas, the eliminating ratio is as high as 90 to 98%. On the absorbing solution side, a product with high purity that can be used for preparing products of reagent pure grade can be obtained.

Next, a specific embodiment for illustrating the technical solution will be described referring to the attached figure.

The attached figure shows a schematic structure of a embodiment of the present utility model. Case 2 is a pipe of ABS plastic. The case is installed with cylindrical hydrophobic hollow fiber microporous membrane, which is composed by ultrafine fiber 3 with micropores on the hollow wall thereof. The two ends of the membrane are bonded by epoxy resin. The materials for the hydrophobic hollow fiber microporous membrane is polypropylene or polyethylene. An inlet nozzle 5 for the incoming mixed gas such as regeneration gas consisting of CO, NH_3, H_2, N_2, etc, and an outlet nozzle 1 for the mixed gas after component separation are provided on the case. A pair of inlet nozzle 8 and outlet nozzle 6 for the absorbing solution such as H_2SO_4 is also provided on the case. The pipeline is provided with pump 7 and reservoir 10 of the absorbing solution for supplying the absorbing solution. As shown by a partial enlarged view marked as P in the figure, all gaps between the hollow fibers 3 are filled with absorbing solution 9 (H_2SO_4). The absorbing solution cannot enter into the hollow part of the fiber through the micropores on the wall of fibers whereas each component in the mixed gas, i.e. CO, NH_3, H_2, N_2 can enter into the

absorbing solution from the hollow part of the fiber by passing through the micropores. But only NH_3, which is the component to be eliminated, can react with absorbing solution (H_2SO_4) irreversibly according to the following formula: $NH_3+H^+ \rightarrow NH_4^+$. Thus a thiamine solution, which can be subjected to post treatment to yield refined thiamine, can be generated continuously. Components other than NH_3 such as CO, H_2, N_2 are expelled by way of outlet nozzle 1. Thus, the purpose for separating the NH_3 can be realized.

In a second embodiment, marsh gas or natural gas mainly consisting of CH_4, H_2S and CO_2 is introduced into polypropylene hollow fiber microporous membrane. The components that need to be eliminated are CO_2 and H_2S. The absorbing solution used is NaOH since H_2S and CO_2 will react irreversibly with NaOH but CH_4 does not. Thus, components of H_2S and CO_2 can be eliminated and pure CH_4 remains eventually.